CLAIMS

1. A method comprising:

combusting a feed stream to form combustion products; and

reforming the combustion products to produce a gaseous composition comprising hydrogen.

2. The method of Claim 1, wherein the feed stream comprises a mixture of air or oxygen and hydrocarbon, wherein a molar ratio of oxygen to hydrocarbon is about 0.05 to about 2.0.

3. The method of Claim 2, wherein the hydrocarbon is selected from a group consisting of alkanes, alkenes, alkynes, or a combination comprising at least one of the foregoing hydrocarbons.

4. The method of Claim 3, wherein the hydrocarbon is methane or natural gas.

5. The method of Claim 1, wherein a temperature of the feed stream prior to combustion is about 18 to about 800°C

6. The method of Claim 1, further comprising utilizing heat from a byproduct to preheat the feed stream prior to introduction into the cyclical compression chamber.

7. The method of Claim 1, further comprising compressing the feed stream prior to combustion.

8. The method of Claim 1, wherein combustion occurs within a cyclical compression chamber in mechanical communication with a reciprocating piston or a rotary piston.

9. The method of Claim 8, wherein the pressure within the cyclical compression chamber has a volumetric compression ratio of greater than or equal to about 3:1.

10. The method of Claim 1, wherein the reforming occurs within a reforming section, and wherein the reforming section is downstream of and in fluid communication with the cyclical compression chamber.

11. The method of Claim 10, wherein pre-heated steam or a pre-heated mixture of steam and hydrocarbon is introduced into the reforming section prior to reforming.

12. The method of Claim 10, wherein the reforming section contains a catalyst.

13. The method of Claim 11, wherein the catalyst is a metal, an oxide of a transition metal, an oxide of an alkali earth metal, an oxide of a main group element or a combination comprising at least one of the foregoing catalysts.

14. The method of Claim 1, further comprising separating hydrogen from the gaseous composition comprising hydrogen.

15. A method for producing hydrogen comprising:

introducing a feed stream comprising natural gas and air or oxygen into a cyclical compression chamber;

compressing the feed stream in the cyclical compression chamber;

combusting the feed stream in the cyclical compression chamber to produce combustion products;

discharging the combustion products from the cyclical compression chamber into a reforming section; and

reforming the combustion products with steam in the reforming section to produce a gaseous composition comprising hydrogen.

16 The method of Claim 15, wherein the feed stream comprises a mixture of air or oxygen and methane, wherein a molar ratio of oxygen to methane is about 0.10 to about 0.50.

17. The method of Claim 15, wherein a temperature of the feed stream prior to combustion is about 18 to about 800°C.

18. The method of Claim 15, wherein the compression is conducted at a volumetric compression ratio of greater than or equal to about 3:1.

19. The method of Claim 15, wherein the ratio of added steam to carbon content in the hydrocarbons in the combustion products in the reforming section is about 1 to about 4.

20. The method of Claim 15, further comprising separating hydrogen from the gaseous composition.

21. The method of Claim 15, wherein the reforming section contains a catalyst.

22. The method of Claim 21, wherein the catalyst is a metal, an oxide of a transition metal, an oxide of an alkali earth metal, an oxide of a main group element or a combination comprising at least one of the foregoing catalysts.

23. A device employing the method of Claim 1.

24. A device employing the method of Claim 15.

25. A device for producing hydrogen comprising:

a cyclical compression chamber located upstream of and in fluid communication with a reforming section.

26. The device of Claim 25, wherein the cyclical compression chamber operates at a pressure of about 10 to about 100 kg/cm^2, and a temperature of about 800 to about 1,500°C during combustion.

27. The device of Claim 25, wherein the reforming section comprises a fluidized bed, a cylindrical compression chamber, a plug flow reactor, catalytic oxidation reactors, fuel reformer catalytic reactors, or a combination comprising at least one of the foregoing reactors.

28. The device of Claim 27, wherein the plug flow reactor comprises a monolithic catalyst derived from metals, and wherein the metals are nickel, iron, zinc, copper, palladium, platinum, rhodium, or a combination comprising at least one of the foregoing metals.

29. The device of Claim 27, wherein the fluidized bed comprises metal catalysts disposed upon supports having a surface area greater than or equal to about 10 square meters per gram (m^2/gm), and wherein the supports are fumed silica, fumed alumina, alpha alumina, gamma-alumina, delta alumina, titania, ceria, or the like, or a combination comprising at least one of the foregoing supports.

30. The device of Claim 25, further comprising a hydrogen separator located downstream of and in fluid communication with the reforming section.

31. The device of Claim 30, wherein the hydrogen separator employs membrane separation to obtain hydrogen, and wherein the membranes are organic membranes comprising thermoplastic polymers, thermosetting polymers, or a combination of thermoplastic polymers and thermosetting polymers.

32. The device of Claim 31, wherein the membrane separation uses a polyimide membrane.

33. The device of Claim 30, wherein the hydrogen separator employs pressure swing adsorption to obtain hydrogen.

34. The device of Claim 25, further comprising a heat exchanger located downstream of and in fluid communication with the hydrogen separator.

35. The device of Claim 34, wherein the feed stream is preheated in the heat exchanger by using heat derived from by products.